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Science Response 2014/012

Maritimes Region

EASTERN SCOTIAN SHELF SHRIMP STOCK STATUS UPDATE FOR 2013-2014

Context

Advice on the status of the eastern Scotian Shelf (ESS) Shrimp stock is requested annually by Fisheries and Oceans Canada (DFO) Fisheries and Aquaculture Management Branch and industry to help determine a Total Allowable Catch (TAC) that is consistent with the Integrated Fishery Management Plan (IFMP). The current report provides information on the stock status for 2013 and advice for management of the 2014 fishery.

This Science Response Report results from the Science Response Process of 13 December 2013 on the Assessment of Eastern Scotian Shelf Shrimp Update.

Background

Science advice for the ESS Shrimp fishery had been provided annually in the form of a full assessment supported by a Research Document and Science Advisory Report. In 2012 it was decided that full assessments would take place bi-annually with a stock status update in between. The DFO-industry survey and complete analysis of fishery dependent and independent data is still carried out on an annual basis (i.e. even in interim years) but only the most informative and important results of the assessment are provided here in the form of a Science Response.

Description of the Fishery

The trawl fishery on the Scotian Shelf occurs primarily during spring and early summer with some fishing during fall, in the deep offshore shrimp "holes", and on an inshore area near the Bad Neighbour Shoal (Figure 1). The main management tools are limits on the number of licenses and size of vessels used, minimum codend mesh size (40 mm), use of a Nordmøre separator grate, and a TAC. This fleet (about 17 active licenses) is divided into two sectors, a midshore sector consisting of vessels 65-100' Length Over All (LOA) based in New Brunswick in the Gulf Region, and an inshore sector consisting of vessels mainly <65' LOA based in the Maritimes Region. A trap fishery, currently consisting of 8 active licenses is restricted to Chedabucto Bay. The allocation of quota to the Chedabucto Bay trap fishery currently stands at 8% of the TAC.

Although there has been some Shrimp fishing on the Scotian Shelf since the 1960s, the Nova Scotia fishery began to expand toward its full potential only when groundfish bycatch restrictions were overcome with the introduction of the Nordmøre grate in 1991 (Figure 2). The TAC was first reached in 1994, when individual Shrimp Fishing Area (SFAs) quotas were removed. Since that time, the TAC has fluctuated between 3100 – 5500 mt, mostly in response to the influence of strong recruitment events (large year classes) on spawning stock and fishable biomass. The TAC for 2013 was 3800 mt. The most recent strong year classes for which there is compelling evidence are the 2007 and 2008 year classes (Hardie et al. 2013). These year classes support the current high biomass but no strong year classes have been apparent since 2009.

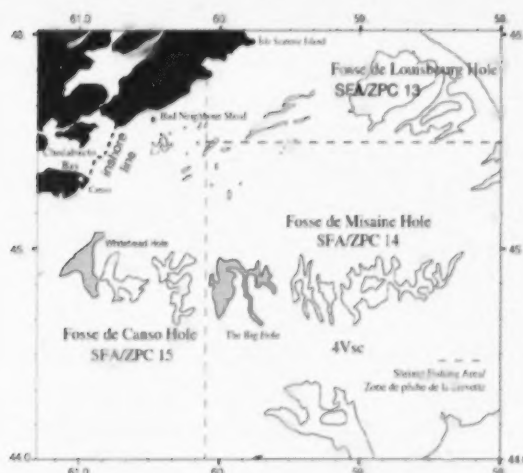


Figure 1. Shrimp Fishing Areas on the eastern Scotian Shelf.

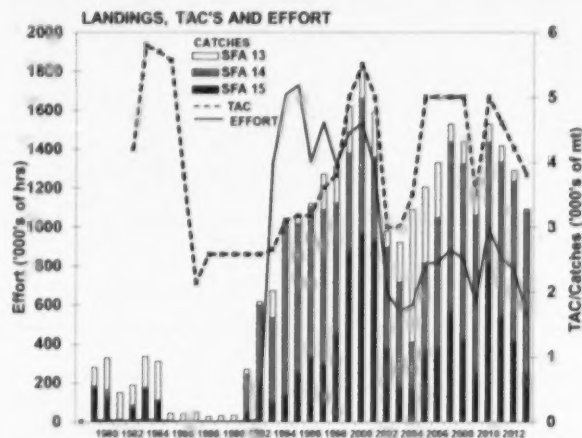


Figure 2. History of eastern Scotian Shelf Shrimp fishery showing catches per SFA, TAC, and effort up to December 13, 2013.

Analysis and Response

The stock assessment for ESS Shrimp uses a "Traffic Light" analysis (Koeller et al. 2000, Mohn et al. 2001, Halliday et al. 2001) that is based on a multiple indicator diagnostic approach, with discussion of individual indicators grouped under headings representing four "characteristics" (see Hardie et al. 2013 for most recent full assessment).

A precautionary approach using reference points and control rules within the framework of the Traffic Light analysis has been used in recent assessments for this stock. In general, the precautionary application of reference points for ESS Shrimp includes a limit reference point (LRP) and upper stock references (USR), which are 30% and 80% of the average spawning stock biomass (SSB) maintained during the high productivity period of the modern fishery (2000-2010) respectively. A maximum removal reference point of 20% female exploitation is used to help guide management decisions (see Hardie et al. 2013 for details and recent application).

Data used in this assessment include commercial catch data, survey catch per unit effort (CPUE) data (raised to total biomass using swept area method), detailed Shrimp biological data (commercial and survey samples), survey data for other marine species, and various environmental data (see Hardie et al. 2013 for details).

Indicators of the Stock Status

After three consecutive years of decline, the stratified survey estimate for 2013 (representing a total biomass of 39,385 $\pm$ 6,947 mt using the swept area method) increased by approximately 40% relative to the 2012 estimate. Biomass estimates increased in all survey strata except for stratum 15, where the biomass estimate decreased for the 4th consecutive year to the lowest value in the past decade (Figure 3). The increase in the 2013 survey abundance index value is generally consistent with increases in commercial CPUEs (Figure 4).

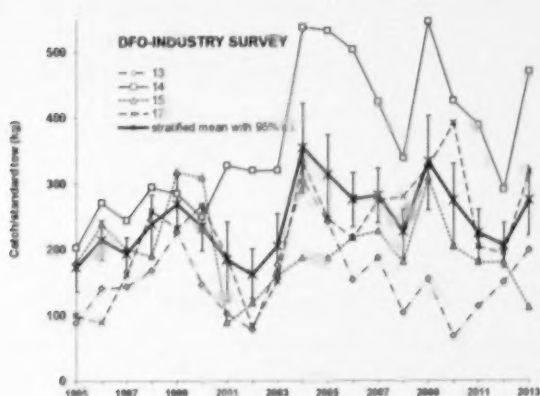


Figure 3. Survey CPUEs overall and by survey stratum.

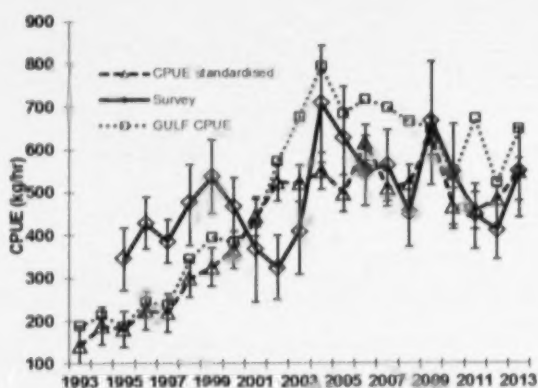


Figure 4. Commercial and survey CPUEs.

The point estimate of SSB increased for the first time since 2009 to 20,680 mt (Figure 5), well above the USR of 14,558 mt, in the Healthy Zone. Female exploitation if the TAC is reached will be less than 15%, well below the Removal Reference.

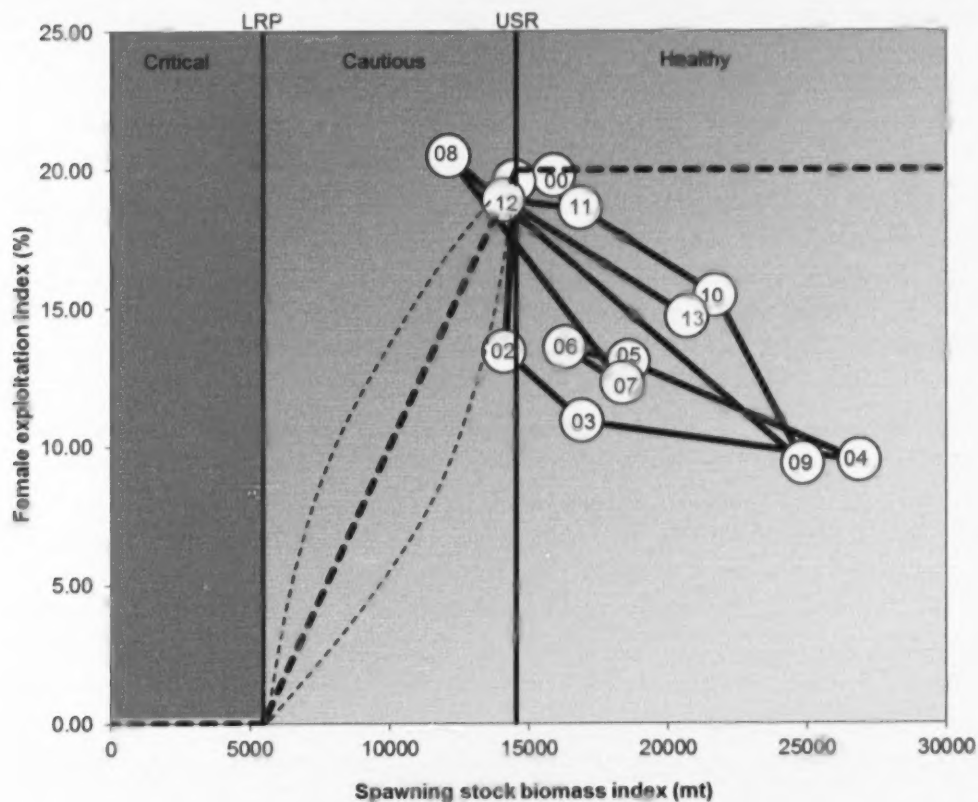


Figure 5. Graphical representation of the precautionary approach for Eastern Scotian Shelf Shrimp.

The population is currently dominated by large female Shrimp, representing the strong recruitment of the large 2007 and 2008 year classes to the SSB. This is evident in the 2013 length frequencies of Shrimp from the survey (Figure 6), which are skewed towards larger Shrimp with little/no evidence of strong following year classes. By contrast, note the broad, multimodal length frequency distribution in the 2010 panel and the clearly defined peak of the 2001 year class moving through the length range from 2004-2008.

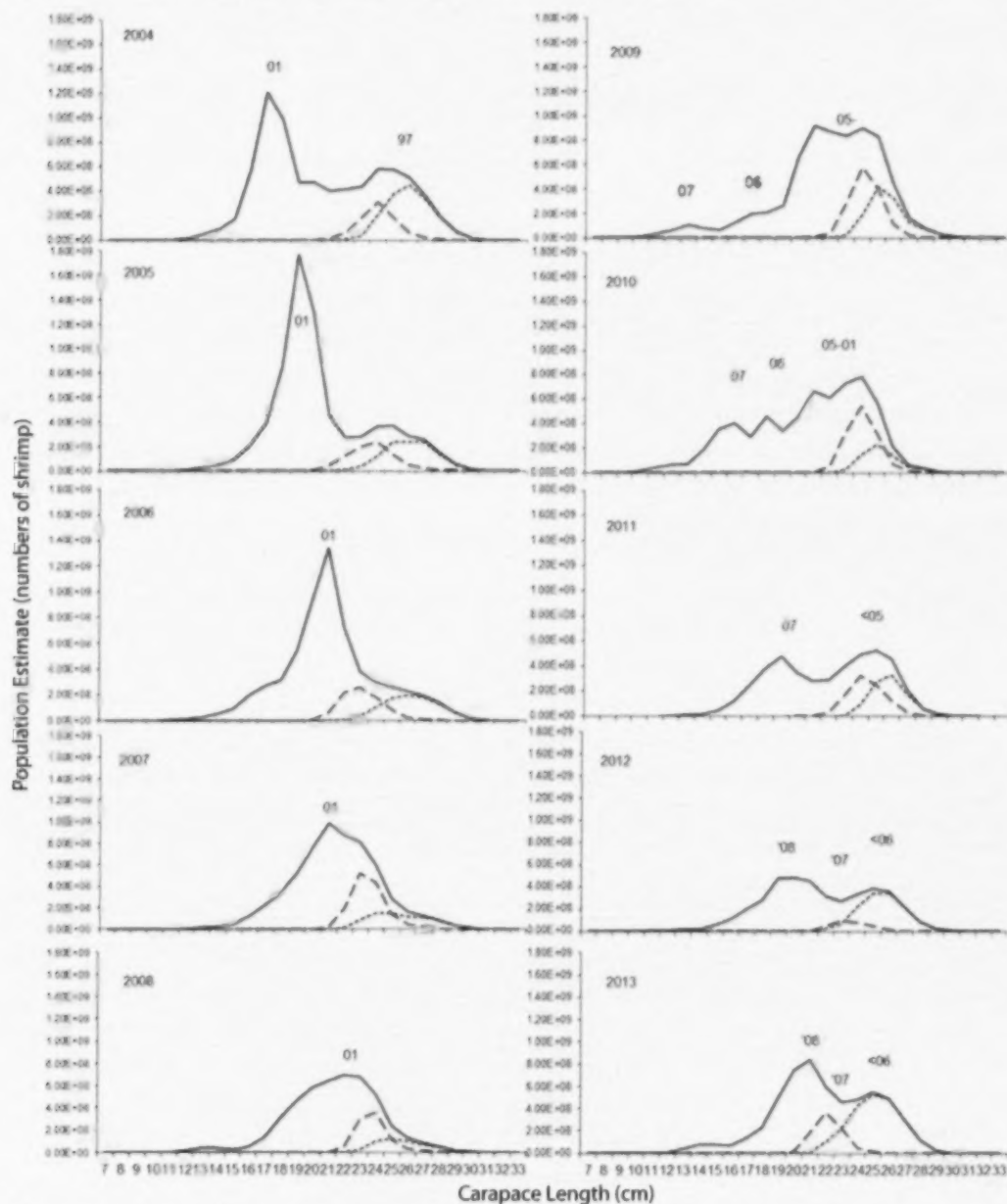


Figure 6. Population estimates of number at length from DFO-industry surveys 2004-2013 (solid line). The heavy dotted line in each figure represents transitional and primiparous Shrimp, and the stippled line represents multiparous Shrimp.

Modal analysis (see Hardie et al. 2013 for details) provides further support for the high proportional abundance of female Shrimp relative to younger male Shrimp from year classes succeeding the 2008 year class (Figure 7). In fact, the abundance of multiparous female Shrimp is the highest on record, more than double the average abundance estimate, while male abundance is very low. The 2013 belly bag index of juvenile recruitment is the lowest on record; 25 million relative to a range of 25-980 million and an average of 286 million.

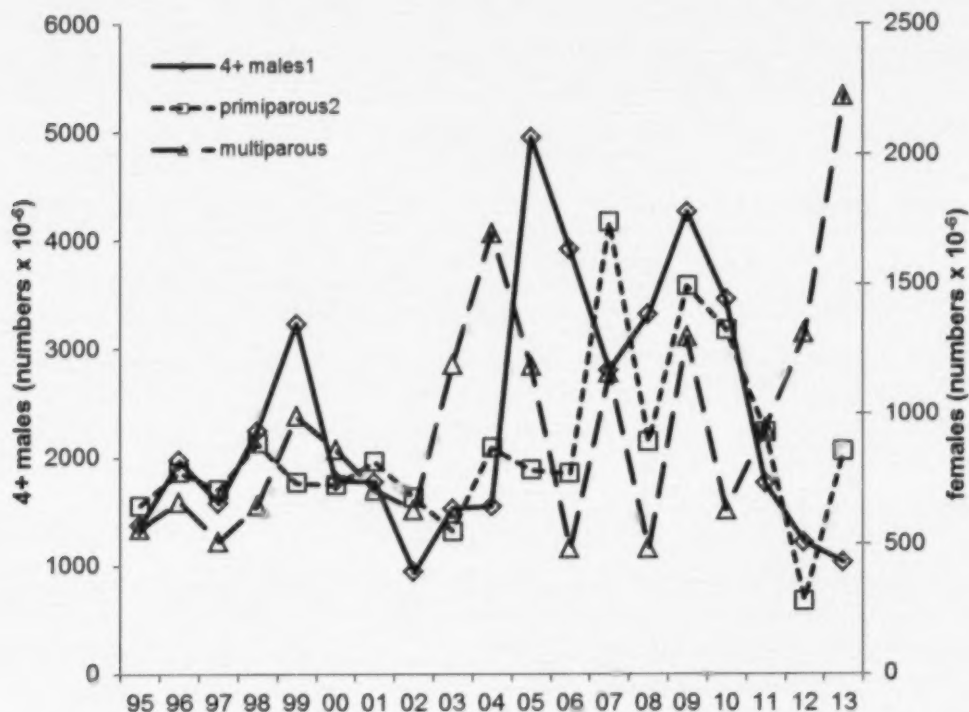


Figure 7. Population estimates of age 4 and older male, primiparous female, and multiparous female Shrimp from the survey.

The summary indicator for the Traffic Light Analysis for 2013 improved to yellow after having been red in 2011 and 2012 (Figure 8). The *Abundance Characteristic* improved from yellow to green in 2013, reflecting improvements in commercial and survey CPUE indices of abundance. The *Production Characteristic* declined from green to yellow for 2013 despite very high SSB, reflecting the extremely low belly-bag index of juvenile recruitment. The *Fishing Effects Characteristic* improved from red to green, reflecting the low total and female exploitation indices. The *Ecosystem Characteristic* remained red for 2013 because temperatures indices remained unfavourable (warm) for Shrimp. While the recruitment index for Greenland Halibut improved from yellow to green, Cod recruitment (an index of predation on Shrimp) increased from yellow to red. Background information on each indicator including its polarity are given in Hardie et al. (2013).

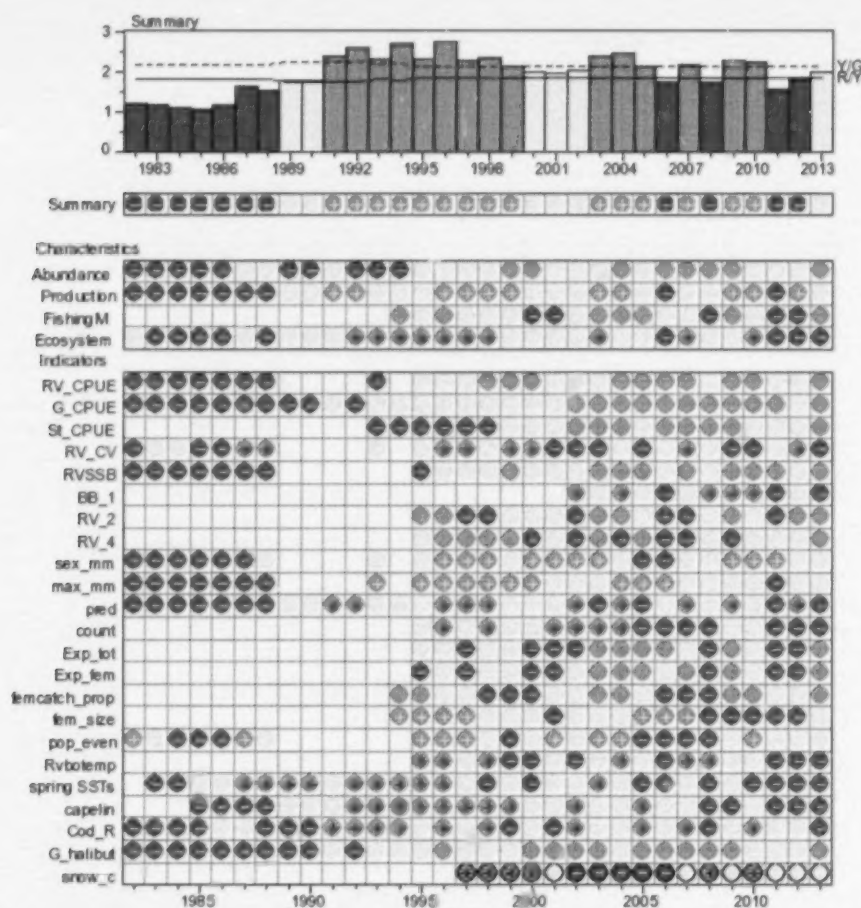


Figure 8. Traffic Light Analysis summary for 2013 with all available indicators.

Conclusions

The ESS Shrimp stock is currently in the Healthy Zone and exploitation is below the Removal Reference. The stock is dominated by the abundant 2007 and 2008 year classes which are currently adult primiparous and multiparous females that account for the high SSB. Despite high SSB, the index of juvenile recruitment for 2013 was the lowest on record, which may be related to unfavourably warm ocean conditions for spawning success. The right-skewed length frequency distribution in survey samples is consistent with the lack of a strong signal of juvenile recruitment since 2009 (2008 year class). As the 2007 and 2008 year classes begin to reach the end of their expected lifespan (6-8 years) the stock is expected to begin to gradually decline as the less abundant succeeding year classes enter the spawning stock. However, given that the stock is currently at a very high abundance level, and that the decline is expected to begin gradually, a modest increase in the TAC is supported for the 2014 fishery. Reactive TAC reductions will be required immediately when the stock begins to show signs of the anticipated decline.

Complete stock assessment advice supported by a Research Document and Stock Assessment Report will be provided for the ESS shrimp stock in 2014 and bi-annually thereafter. A

Framework meeting will be held in 2015 to evaluate the current assessment methodology against alternative methods.

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Sources of Information

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